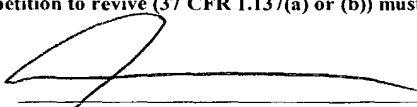


JP03 Rec'd PCT/PTO 01 MAR 2002

FORM PTO-1390) (REV. 9-2001)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER 306.41247X00 filed March 1, 2002
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 10/069877
INTERNATIONAL APPLICATION NO PCT/EP00/08427	INTERNATIONAL FILING DATE August 20, 2000	PRIORITY DATE CLAIMED September 11, 1999	
TITLE OF INVENTION CARBON-FIBRE-REINFORCED SMC FOR MULTI-AXIALLY REINFORCED COMPONENTS			
APPLICANT(S) FOR DO/EO/US EHNERT, GERD BIENIEK, KLAUS			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:			
<ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below. 4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31). 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> a. <input type="checkbox"/> is transmitted hereto (required only if not communicated by the International Bureau). b. <input checked="" type="checkbox"/> has been communicated by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office(RO/US) 6. <input checked="" type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)). <ol style="list-style-type: none"> a. <input checked="" type="checkbox"/> is attached hereto. b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4). 7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau). b. <input type="checkbox"/> have been communicated by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). 9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). 10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). <p>Items 11 to 20 below concern document(s) or information included:</p> <ol style="list-style-type: none"> 11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. 12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. 13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. 14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 15. <input type="checkbox"/> A substitute specification. 16. <input checked="" type="checkbox"/> A change of power of attorney and/or address letter. 17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825. 18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4). 19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4). 20. <input checked="" type="checkbox"/> Other items or information: Figs. 1-7, Credit Card Payment Form, International Preliminary Examination Report, PCT Request Form, International Publication Number WO 01/19599 			

U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 10/069877				INTERNATIONAL APPLICATION NO. PCT/EP00/08427		ATTORNEY'S DOCKET NUMBER 306.41247X00	
21. The following fees are submitted BASIC NATIONAL FEE (37 CFR 1.492(a) (1) - (5)): <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO. \$1040.00 <input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO .. \$740.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4). \$710.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4). \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =						CALCULATIONS PTO USE ONLY	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).						\$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$			
Total Claims	26 - 20 =	6	x \$18.00	\$108.00			
Independent Claims	1 - 3 =	0	x \$84.00	\$			
MULTIPLE DEPENDENT CLAIMS(S) (if applicable)			+ \$280.00	\$			
TOTAL OF ABOVE CALCULATIONS =				\$998.00			
<input type="checkbox"/> Applicant claims small entity status See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$			
SUBTOTAL =				\$998.00			
Processing fee of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f))				\$			
TOTAL NATIONAL FEE =				\$998.00			
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				\$			
TOTAL FEES ENCLOSED =				\$998.00			
				Amount to be refunded:		\$	
				charged:		\$	
a. <input type="checkbox"/> A check in the amount of \$_____ to cover the fees is enclosed b. <input type="checkbox"/> Please charge my Deposit Account No. 01-2135 in the amount of \$_____ to cover the above fees. A duplicate copy of this sheet is enclosed c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 01-2135 . A duplicate copy of this sheet is enclosed d. <input checked="" type="checkbox"/> Fees are to be charged to a credit card WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.							
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.							
SEND ALL CORRESPONDENCE TO Antonelli, Terry, Stout & Kraus, LLP 1300 North Seventeenth Street Suite 1800 Arlington, VA 22209 USA							
				 SIGNATURE			
				Alan E. Schiavelli NAME			
				32,087 REGISTRATION NO			

612.41247X00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: EHNERT et al

Serial No.:

Filed: March 1, 2002

For: Carbon-Fibre-Reinforced SMC For Multi-Axially
Reinforced Components

Group:

Examiner:

PRELIMINARY AMENDMENT

Assistant Commissioner
for Patents
Washington, D.C. 20231

March 1, 2002

Sir:

Prior to examination on the merits of this application and prior to calculation
of the filing fee, please amend the above-identified application as follows:

IN THE CLAIMS:

Please amend the claims to read as follows:

6. (Amended) SMC according to Claim 1, characterised in that the UD fibres (7) are shortened by incisions in the finished SMC to produce flowability in the fibre direction.
8. (Amended) SMC according to Claim 1, characterised in that a different resin matrix (2) is used for the random fibres (4) and the UD fibres (7).
9. (Amended) SMC according to Claim 1, characterised in that, to check the UD fibre directions, individual UD glass fibres are introduced into the matrix (2) in the

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10. (Amended) SMC according to Claim 1, characterised in that the SMC weight per unit area is less than 1000 gram/m².

11. (Amended) SMC according to Claim 1, characterised in that the resin matrix (2) contains electrically conductive additives.

12. (Amended) Process for producing a fibre-reinforced SMC according to Claim 1, characterised

- in that SMC mats with a single layer of UD fibres (7) are produced

and

- in that a plurality of SMC mats is arranged, prior to further processing to form the component (16), with multi-axial alignment of the UD fibres (7) by building up into a stack (19).

14. (Amended) Process according to Claim 12, characterised in that at least four UD fibre layers (7) are arranged.

16. (Amended) Process according to Claim 12, characterised in that at least six UD fibre layers (7) are arranged.

18. (Amended) Process according to Claim 12, characterised in that eight UD fibre layers (7) are arranged.

20. (Amended) Process according to Claim 12, characterised

- in that the SMC mats are cut into strips (12) and wound onto spools or reels (8),

- in that the strips (12) are cut to length and arranged in rectangular blank layers

and

- in that the individual blank layers (11) are built up into a stack (19) on a rotary

table (14).

23. (Amended) Process according to Claim 1, characterised in that the strips (12) are wound onto spools with a core diameter of greater than 200 mm and an outside diameter of greater than 500 mm.

24. (Amended) Process according to Claim 1, characterised in that the SMC is flowable and the blank size is always smaller than the laid out component surface.

25. (Amended) Component made of fibre-reinforced thermosets, characterised in that this component is produced from an SMC according to Claim 1.


REMARKS

The foregoing amendments are respectfully requested prior to examination on the merits of this application. A marked up copy of the amended claims is attached.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 612.41247X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP


Alan E. Schiavelli
Registration No. 32,087

AES/jla
(703) 312-6600

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least six UD fibre layers (7) are arranged.

18. (Amended) Process according to Claim 12 ~~or 13~~, characterised in that eight UD fibre layers (7) are arranged.

20. (Amended) Process according to ~~one of Claims 12 to 19~~ Claim 12,
characterised

- in that the SMC mats are cut into strips (12) and wound onto spools or reels (8),
- in that the strips (12) are cut to length and arranged in rectangular blank layers and
- in that the individual blank layers (11) are built up into a stack (19) on a rotary table (14).

23. (Amended) Process according to ~~one of the preceding claims~~ Claim 1, characterised in that the strips (12) are wound onto spools with a core diameter of greater than 200 mm and an outside diameter of greater than 500 mm.

24. (Amended) Process according to ~~one of the preceding claims~~ Claim 1, characterised in that the SMC is flowable and the blank size is always smaller than the laid out component surface.

25. (Amended) Component made of fibre-reinforced thermosets, characterised in that this component is produced from an SMC according to ~~one of Claims 1 to 24~~ Claim 1.

7/pst

Carbon-fibre-reinforced SMC for multi-axially reinforced components

The invention relates to an SMC for producing fibre-reinforced thermosetting components, a corresponding production process and a component produced from this SMC.

SMC stands for "Sheet Moulding Compound" and is a resin mat according to DIN 16913. In general, SMC refers to a flowable resin mat based on unsaturated polyester resin or vinyl ester resin and random fibre distribution in the plane of the mat. The reinforcing fibres customarily used are glass fibres. A typical SMC formulation consists of about 30% of polymer, about 30% of filler and about 30% of glass fibres, the remainder being composed of additives, such as, for example, colouring pigments, hardeners, dispersing auxiliaries, fillers and similar materials. SMC is generally produced as follows: the resin matrix is applied to two carrier films. These carrier films are drawn through an SMC machine and in the process transport the resin matrix, onto which the reinforcing fibres are sprinkled or laid. Once the reinforcing fibres have been deposited, the two films are pressed together to produce a kind of sandwich. This sandwich is transported through an impregnating section, which uses pushing and rocking movements to ensure that the fibres are uniformly wetted with the resin matrix. At the end of the machine, it is wound onto reels. Of crucial importance is a ripening process, which may be initiated by chemical and/or physical means. After this ripening process, the SMC can be further processed. After stripping off of the carrier foils, the SMC is customarily processed or pressed in heated steel moulds to form shaped parts.

The advantage of SMC is the high flowability, which has the effect that only 30 to 50% of the pressing mould has to be covered. The strength and stiffness can be varied in a wide range, depending on the reinforcing-fibre content.

As an alternative, it is known to place a woven fabric in the resin matrix for reinforcement. The disadvantage of this is that, although the strength is substantially increased, there is hardly any flowability. The pressing mould must be completely covered, which requires exact cutting to size, resulting in a lot of waste.

Furthermore, SMC with a glass-fibre reinforcement comprising both cut fibres (random fibres) and unidirectional fibres (UD fibres) is known. The UD fibres produce increased strength and stiffness properties in an axial direction and the random fibres determine the transverse strength. This SMC is preferably employed only for support-type components, such as, for example, bumper supports. It is not possible to produce sheet-like components because of the high tendency of the components to become distorted.

The object on which the invention is based is to develop an SMC for producing fibre-reinforced thermosetting components according to the preamble such that a high strength and stiffness in a multi-axial direction is achieved in sheet-like thin-walled components. The basis for this is an SMC with an asymmetrical fibre structure, comprising a random fibre side and a UD fibre side.

According to the invention, this object is achieved in that several layers of SMC containing UD fibres with a different axial alignment from one another are arranged

in the component. Since the UD fibres govern the strength and stiffness properties, these properties are not only provided in an axial direction but in different directions. Owing to the high strength and stiffness, it is possible to produce lightweight components or ones with a thin wall structure.

In order to be able to produce a multi-layer SMC structure with desired component wall thicknesses of about 1.2 mm and large SMC as cut dimensions, the SMC weight per unit area must be less than 1000 g/m².

Until now, it has not been possible either to produce such low SMC weights per unit area industrially, or effectively from the point of view of strength and stiffness. The development of such an SMC has become interesting only with a UD carbon-fibre reinforcement and the resulting strength and stiffness properties for a multi-axial reinforcement in the component.

In comparison with the customary process techniques for the production of components from fibre composites with carbon fibres (resin transfer moulding, prepreg processing by the pressing or autoclave process), the SMC on which the invention is based has the following advantages:

- Simple as cut geometries, since despite UD fibre reinforcement the SMC is flowable
- No SMC clippings which have to be disposed of or recycled
- No trimming of the shaped parts, therefore no waste

- Short cycle times of the component production, therefore suitable for mass production.

5 A combination of random fibres formed of glass or carbon fibres with UD carbon fibres is preferred for the asymmetrically reinforced SMC which has been developed.

10 The SMC on which the invention is based covers 60 - 95% of the pressing mould. In order to produce the flowability of the UD carbon fibres in the UD direction, the continuous UD fibres are cut to a finite length. The finite UD fibre lengths may be between 25 mm and 650 mm. The ends of the finite UD fibres are offset from one another in order to avoid weak points in the SMC.

15 In a preferred embodiment, the UD fibre lengths are carbon fibre tows, for example produced by the "heavy tow" process. It is advantageous to use carbon fibres greater than 49 K for this purpose. Alternatively, 20 broad-strip carbon fibre tows produced by the "heavy tow" process in widths of 10 mm to 500 mm can be used.

25 To check the UD fibre directions in the finished shaped part by X-ray inspection, individual glass fibre yarns are introduced into the matrix in the direction of the UD fibres as contrast fibres.

30 To improve the fibre wetting, the flowability and to compensate for shrinkage, a different resin matrix is advantageously used for the random fibres and the UD fibres.

35 It is advantageous to introduce conductive additives into the resin matrix, in order to improve the electrical conductivity to such a degree that an

electrostatic (ESTA) coating is possible without an additional conductive primer on the component.

The surface resistance should be between 10 and $10^6 \Omega$ at
5 5 V and the volume resistance be less than $10^5 \Omega/\text{cm}$.

A process according to the invention for producing a fibre-reinforced SMC having the above-mentioned properties is distinguished in that SMC mats with random fibres and a single layer of UD fibres are produced and in that a plurality of such SMC mats is arranged, prior to further processing to form the shaped part, with multi-axial alignment of the UD fibres by building up into a stack. This has the great advantage that an existing installation for producing an SMC comprising random fibres and UD fibres does not have to be altered. The multi-axial alignment is brought about by the building up of individual SMC mats into a stack, the SMC mats being stacked so as to be rotated relative to one another.

In a preferred embodiment, all the UD fibre layers used are aligned in the 0° direction and any desired number of fibre layers are used.

In an alternative preferred embodiment, at least four UD fibre layers are arranged in the following alignment:

$0^\circ, 90^\circ, 90^\circ, 0^\circ$ or $0^\circ, 90^\circ, 0^\circ, 90^\circ$.

The angles indicate that the next UD fibre layer below is arranged so as to be rotated by this angle relative to the first layer.

In an alternative preferred embodiment, at least six UD
5 fibre layers are arranged. In this case, the UD fibre
layers expediently have the following alignment:

10 In an alternative embodiment, eight UD fibre layers are arranged with the following alignment:

15 For greater wall thicknesses, the material structure can
be laid from multiples of 4 or 6 or 8 layers in the
specified order one above the other.

30 As the final operation, the stack is either placed in the tool (press) for producing the component and the component is pressed or else, as an intermediate stage, is preshaped by prepressing for the purpose of securing, the press for preshaping being an inverse form of the mould for producing the component.

Preferably, the strips are wound onto spools with a core diameter of greater than or equal to 200 mm and an outside diameter of greater than or equal to 500 mm.

- 5 The SMC and processing technology according to the invention is versatile. It is preferably used to produce fibre-reinforced components, in particular for the automotive industry.
- 10 Components can be produced for a wide variety of applications, depending on the resin matrix. Interior and exterior parts joined together result in high strengths and stiffnesses in body elements, for example.
- 15 When using a non-shrinking resin matrix, it is possible to produce exterior parts of motor vehicles with a "class A" surface which, because of their electrical conductivity, can be electrostatically coated like sheet-metal parts.
- 20 Further features of the invention will become apparent from the figures which are described below and in which:
- 25 Fig. 1 shows, schematically, an installation for producing SMC with one UD fibre layer,
- 30 Fig. 2 shows, schematically, an apparatus for producing the blank layers and the multi-axial SMC,
- 35 Fig. 3 shows, schematically, the production of the blank layers and the building up into a stack on a rotary table,
- Fig. 4 shows the pressing to form a shaped part,

cut to length by a cutting tool 10 and displaced,
resulting in a blank layer 11 of virtually any shape
without clipping. The reference numeral 12 denotes the
individual strips after cutting and before displacement.
5 The displacement takes place on a conveying device 13.
The individual layers 11 cut to size are then either
built up into a stack with different axial alignment of
the UD fibres on a rotary table 14 or else fixed
directly by prepressing. The press 15 for preshaping is
10 advantageously an inverse form of the mould for
producing the shaped part.

Fig. 3 shows, schematically, the production of the blank
layers 11 and the building up into a stack on a rotary
15 table 14. The individual reels 8 are cut, according to
requirements, and displaced to form a blank layer 11 and
then stacked on a rotary table 14. This procedure does
not produce any waste or clippings.

20 Fig. 4 shows the pressing to form a shaped part 16. A
stack of built-up blank layers has been preshaped in a
preshaping press 17. This preshaping press 17 is then
placed together with the preshaped part into the press
18, the preshaping press is then withdrawn and the
25 shaped part 16 is pressed.

Fig. 5 shows, by way of example, a built-up stack 19 of
individual blank layers 11. In this example, the stack
19 consists of six layers with an orientation of the UD
30 fibre layers of 0° , 90° , $+45^\circ$, -45° , 90° , 0° .

Fig. 6 shows a finished component (shaped part) 16 with
a schematic arrangement of the individual UD fibre
layers. The building up of the individual cut to size
35 layers 11 can be clearly seen.

Fig. 7 shows the multi-axial alignment of the UD fibre layers at 0° , 90° , $+45^\circ$, -45° , 90° , 0° .

Claims

1. SMC (Sheet Moulding Compound) for producing fibre-reinforced thermosetting components consisting of a resin matrix (2) which is fibre-reinforced with unidirectional fibres (UD fibres) (7) arranged in axial alignment and advantageously with additional cut fibres (random fibres) (4) arranged in non-aligned manner in the resin matrix (2), characterised in that several layers of SMC containing UD fibres (7) with a different axial alignment from one another are arranged in the component.
2. SMC according to Claim 1, characterised in that the random fibres (4) are glass fibres and the UD fibres (7) are carbon fibres or vice versa.
3. SMC according to Claim 1, characterised in that the UD fibres (7) and the random fibres (4) are carbon fibres.
4. SMC according to Claim 1, characterised in that the UD fibres (7) are carbon fibres and no random fibres (4) are used.
5. SMC according to Claim 1, characterised in that the UD fibres (7) are "heavy tow" carbon fibre tows or "heavy tow" broad-strip carbon fibre tows.
6. SMC according to one of Claims 1 to 5, characterised in that the UD fibres (7) are shortened by incisions in the finished SMC to produce flowability in the fibre direction.

7. SMC according to Claim 6, characterised in that the cutting width of the tool for cutting the UD fibre layers is between 2 mm and 15 mm.
- 5 8. SMC according to one of the preceding claims, characterised in that a different resin matrix (2) is used for the random fibres (4) and the UD fibres (7).
- 10 9. SMC according to one of the preceding claims, characterised in that, to check the UD fibre directions, individual UD glass fibres are introduced into the matrix (2) in the direction of the UD carbon fibres (7) as contrast fibres.
- 15 10. SMC according to one of the preceding claims, characterised in that the SMC weight per unit area is less than 1000 gram/m².
- 20 11. SMC according to one of the preceding claims, characterised in that the resin matrix (2) contains electrically conductive additives.
- 25 12. Process for producing a fibre-reinforced SMC, according to one of Claims 1 to 11, characterised
 - in that SMC mats with a single layer of UD fibres (7) are produced and
 - 30 - in that a plurality of SMC mats is arranged, prior to further processing to form the component (16), with multi-axial alignment of the UD fibres (7) by building up into a stack (19).
- 35

13. Process according to Claim 12, characterised in that all the UD fibre layers (7) used are aligned in the 0° direction and any desired number of fibre layers (7) are used.

5

14. Process according to Claim 12 or 13, characterised in that at least four UD fibre layers (7) are arranged.

10

15. Process according to Claim 14, characterised in that the four UD fibre layers (7) have the following alignment

$0^\circ, 90^\circ, 90^\circ, 0^\circ$ or $0^\circ, 90^\circ, 0^\circ, 90^\circ$.

15

16. Process according to Claim 12 or 13, characterised in that at least six UD fibre layers (7) are arranged.

20

17. Process according to Claim 16, characterised in that the six UD fibre layers (7) have the following alignment

$0^\circ, 90^\circ; +45^\circ, -45^\circ, 90^\circ, 0^\circ$.

25

18. Process according to Claim 12 or 13, characterised in that eight UD fibre layers (7) are arranged.

30

19. Process according to Claim 18, characterised in that the eight UD fibre layers (7) have the following alignment

$0^\circ, 90^\circ; +45^\circ, -45^\circ, +45^\circ, -45^\circ, 90^\circ, 0^\circ$.

20. Process according to one of Claims 12 to 19,
characterised

5 - in that the SMC mats are cut into strips (12) and
wound onto spools or reels (8),

- in that the strips (12) are cut to length and
arranged in rectangular blank layers (11) and

10 - in that the individual blank layers (11) are
built up into a stack (19) on a rotary table (14).

21. Process according to Claim 20, characterised in
that the stack (19) is placed into the mould
15 (press) (18) for producing the component (16) or
else is preshaped by prepressing for the purpose of
securing.

22. Process according to Claim 21, characterised in
20 that the press for preshaping is an inverse form of
the mould for producing the component (16).

23. Process according to one of the preceding claims,
characterised in that the strips (12) are wound
25 onto spools with a core diameter of greater than
200 mm and an outside diameter of greater than
500 mm.

24. Process according to one of the preceding claims,
30 characterised in that the SMC is flowable and the
blank size is always smaller than the laid out
component surface.

25. Component made of fibre-reinforced thermosets,
characterised in that this component is produced
from an SMC according to one of Claims 1 to 24.
- 5 26. Component according to Claim 25 for use as an
exterior part of a motor vehicle.

ABSTRACT OF THE DISCLOSURE

The invention relates to an SMC (sheet moulding compound) for producing fibre-reinforced duroplastic components. Said SMC consists of a resin matrix (2) which is fibre-reinforced with unidirectional fibres (UD-fibres) (7) that are arranged in axial alignment and preferably with additional cut fibres (random fibres) (4) that are arranged in a non-aligned manner in the resin matrix. According to the invention, in order to achieve extremely high rigidity in a multi-axial direction with a low surface weight, several layers of SMC are arranged in the component, each layer containing UD-fibres (7) with a different axial alignment from one another.

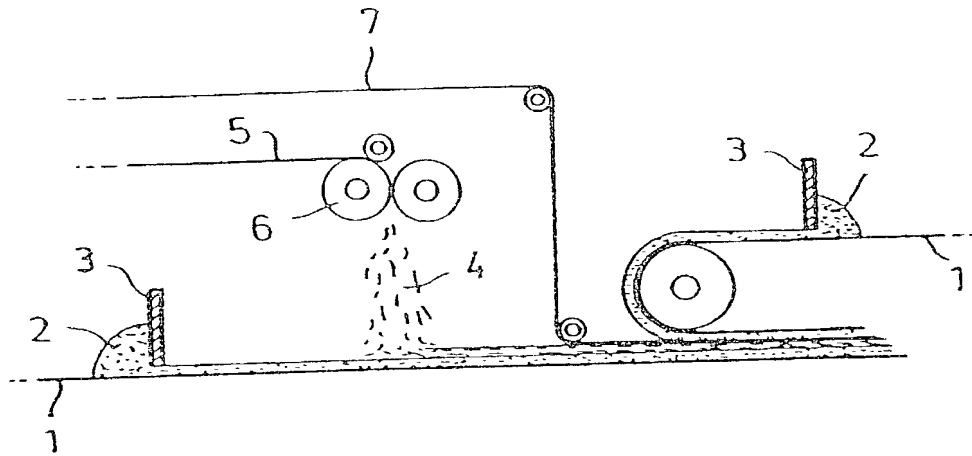
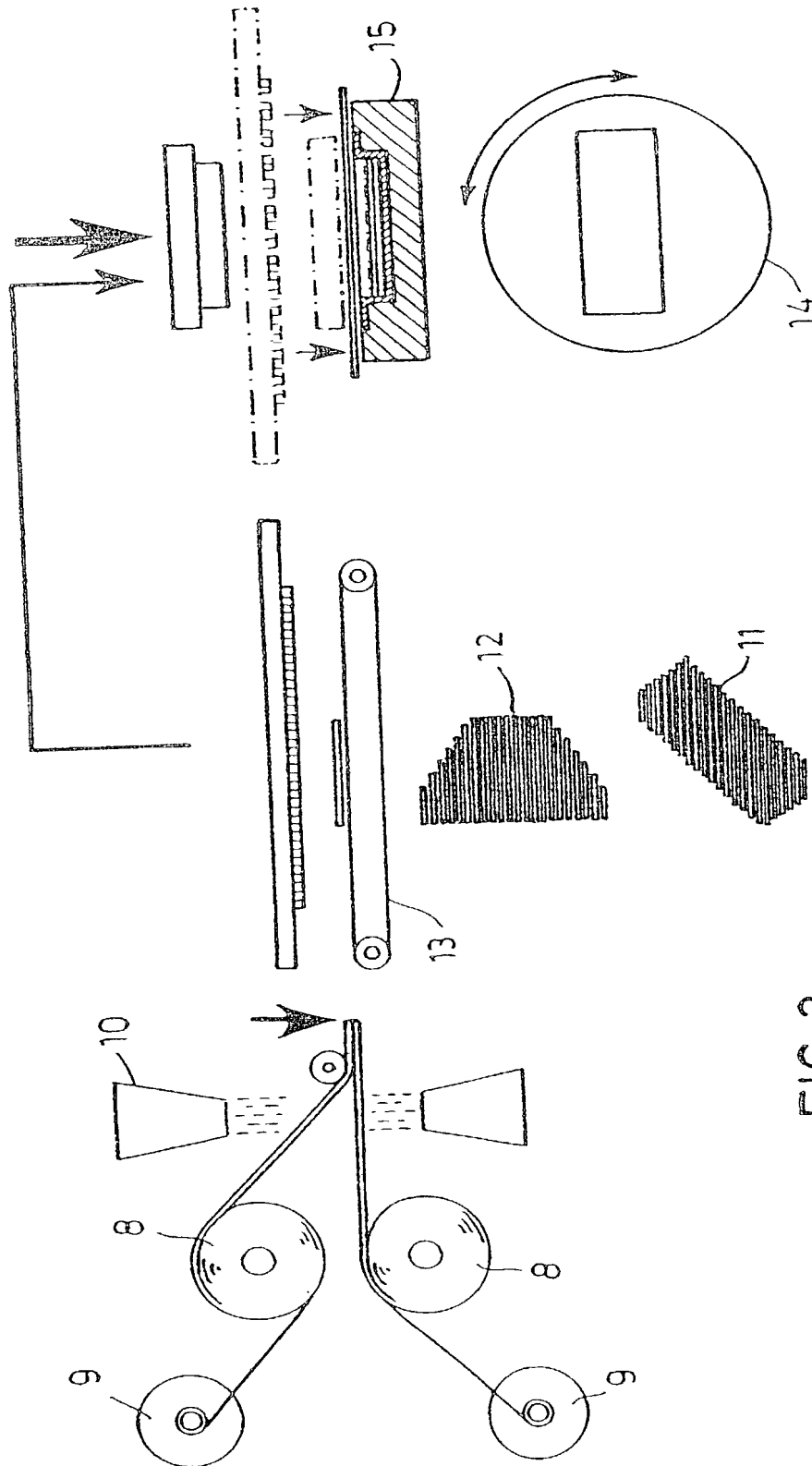


FIG. 1



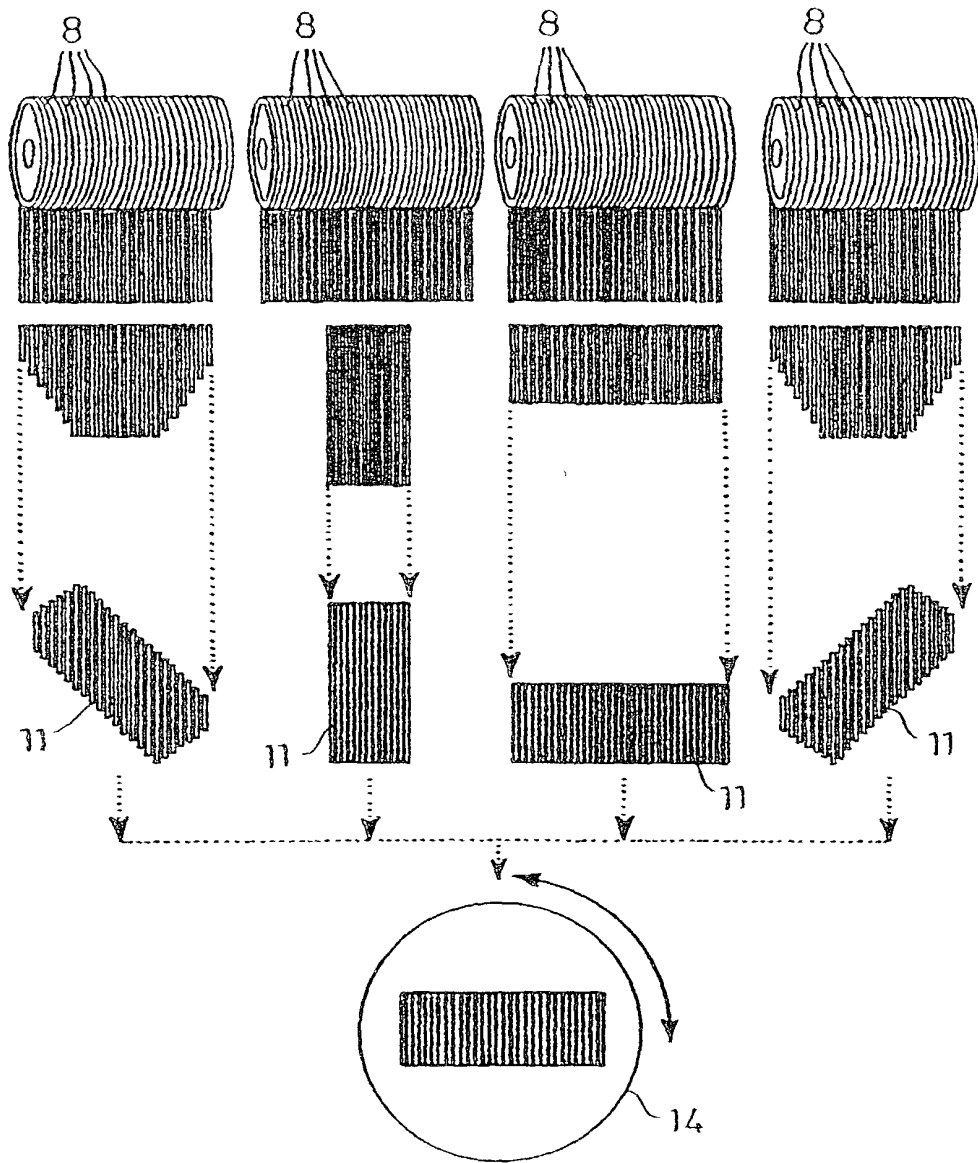


FIG. 3

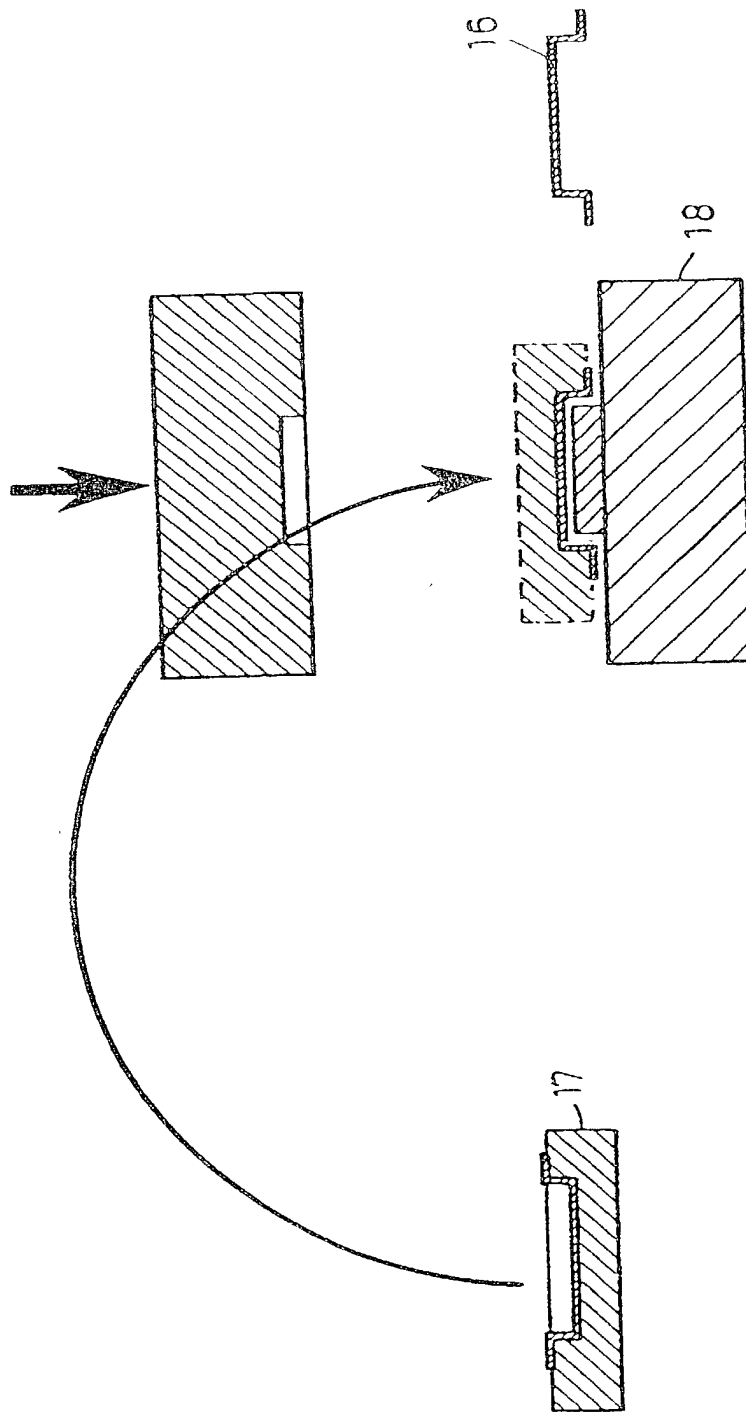


FIG. 4

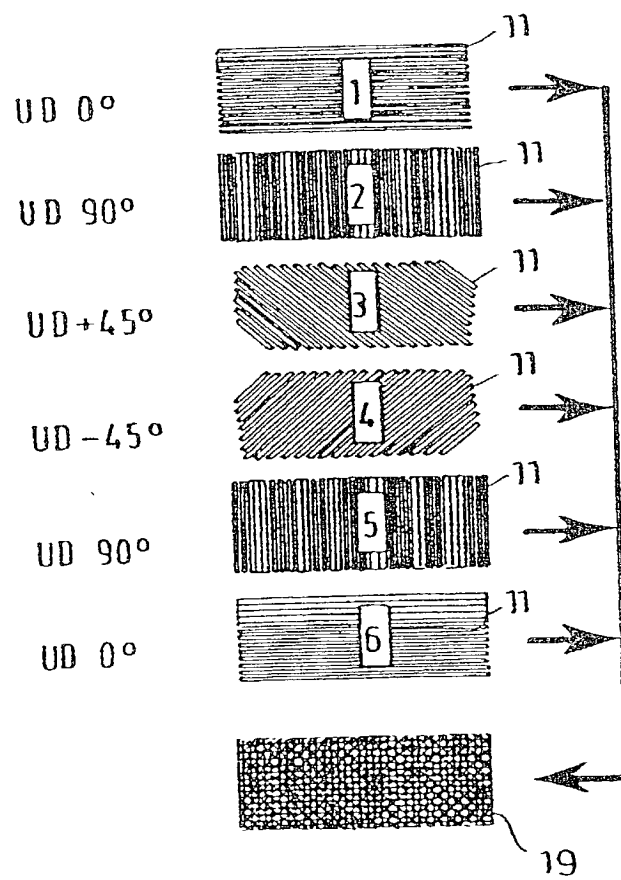


FIG. 5

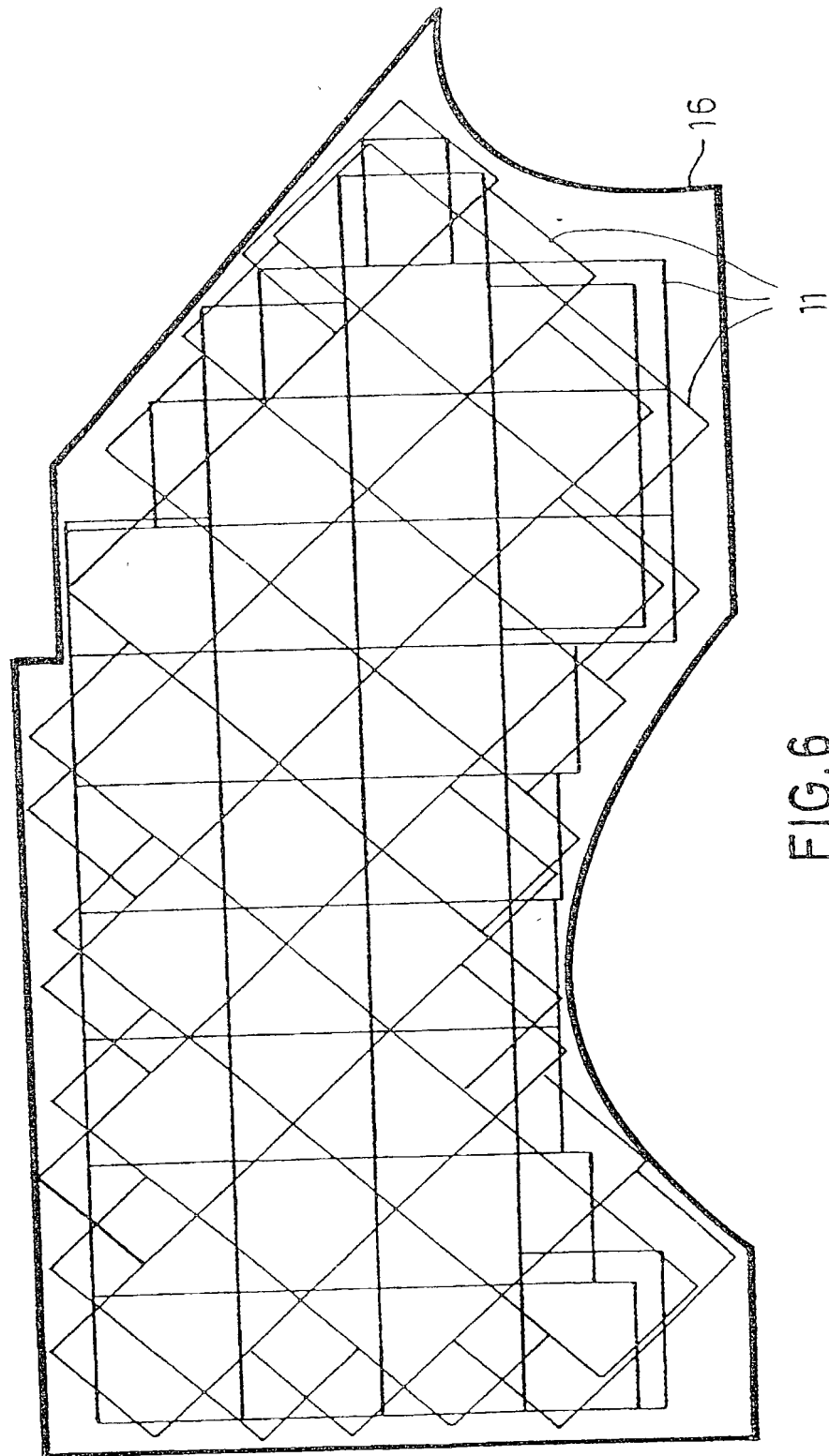


FIG. 6

-7/7-

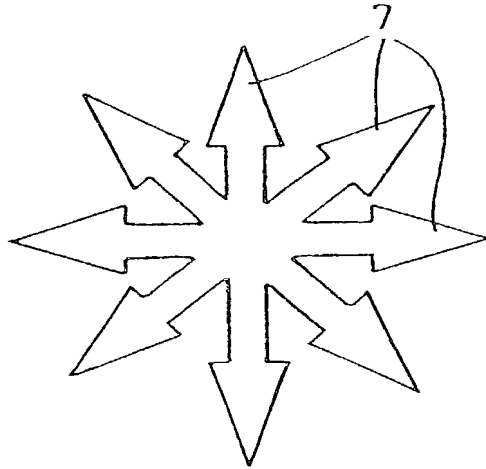


FIG .7

Attorney's Docket No.: 306.41247X00**DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION**

As a below named inventor, I hereby declare that: my residence, post office address and country of citizenship are as stated below, next to my name; I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **CARBON-FIBRE-REINFORCED SMC FOR MULTI-AXIALLY REINFORCED CONCEPTS**

the specification of which

is attached hereto.

Xwas filed on March 1, 2002 asUnited States Application Number 10/069,877or PCT International Application Number PCT/EP00/08427

and was amended on _____

(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)**Priority
Claimed**199 43 442.5
(Number)DE
(Country)11/September/1999
(Day/Month/Year Filed)Yes No199 49 318.9
(Number)DE
(Country)13/October/1999
(Day/Month/Year Filed)Yes No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below

(Application Number)Filing Date(Application Number)Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Attorney's Docket No.: 306.41247X00**DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION**

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Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by 991.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

- (1) Prior art cited in search reports of a foreign patent office in a counterpart application, and
 - (2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.
- (b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and
- (1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or
 - (2) It refutes, or is inconsistent with, a position the applicant takes in:
 - (i) Opposing an argument of unpatentability relied on by the Office, or
 - (ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

- (c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:
- (1) Each inventor named in the application;
 - (2) Each attorney or agent who prepares or prosecutes the application; and
 - (3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.
- (d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

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DN PATENTABTEILUNG

NR. 465 S. 3/11

10004377, 06.12.02

(Application Number)

Filing Date

(Status -- patented,
pending, abandoned)

(Application Number)

Filing Date

(Status -- patented,
pending, abandoned)

I hereby appoint: Donald R. Antonelli, Reg. No. 20,296; Melvin Kraus, Reg. No. 22,466; William I. Solomon, Reg. No. 28,565; Gregory E. Montone, Reg. No. 28,141; Ronald J. Shore, Reg. No. 28,577; Donald E. Stout, Reg. No. 26,422; Alan E. Schiavelli, Reg. No. 32,087; James N. Dresser, Reg. No. 22,973; Carl I. Brundidge, Reg. No. 29,621; Paul J. Skwierawski, Reg. No. 32,173; and Robert M. Bauer, Reg. No. 34,487, my attorneys; of ANTONELLI, TERRY, STOUT & KRAUS, LLP with offices located at 1300 North Seventeenth Street, Suite 1800, Arlington, Virginia 22209, telephone: (703) 312-6600, fax: (703) 312-6666; with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send all correspondence to:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor Gerd EHNERTInventor's Signature [Signature]

Date

05.06.02

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Moulin de Beaulieu, 32190 Vic Fezensac (Gers)FLXFull Name of Second/Joint Inventor Klaus BIENIEK

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Full Name of Third/Joint Inventor

Inventor's Signature

Date

Residence

Citizenship

3 04:16:53 37 Dec 3 1997

Title 37, Code of Federal Regulations, Section 1.56
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DN PATENTABTEILUNG

NR. 465 S. 7/11

10065407 1063.112

(Application Number)

Filing Date

(Status -- patented,
pending, abandoned)

(Application Number)

Filing Date

(Status -- patented,
pending, abandoned)

I hereby appoint: Donald R. Antonelli, Reg. No. 20,296; Melvin Kraus, Reg. No. 22,466; William I. Solomon, Reg. No. 28,565; Gregory E. Montone, Reg. No. 28,141; Ronald J. Shore, Reg. No. 28,577; Donald E. Stout, Reg. No. 26,422; Alan E. Schiavelli, Reg. No. 32,087; James N. Dresser, Reg. No. 22,973; Carl I. Brundidge, Reg. No. 29,621; Paul J. Skwierawski, Reg. No. 32,173; and Robert M. Bauer, Reg. No. 34,487, my attorneys; of ANTONELLI, TERRY, STOUT & KRAUS, LLP with offices located at 1300 North Seventeenth Street, Suite 1800, Arlington, Virginia 22209, telephone: (703) 312-6600, fax: (703) 312-6666; with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

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Full Name of Sole/First Inventor Gerd EHNERTInventor's Signature [Signature]Date [Signature]Residence Same as P.O. Box AddressCitizenship FRANCE

(City, State)

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Full Name of Third/Joint Inventor _____

Inventor's Signature _____

Date _____

Residence _____

Citizenship _____

11. JUN. 2002 9:31

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NR. 465 S. 8/11

1306937 05.11.02

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Full Name of Fourth/Joint Inventor _____

Inventor's Signature _____ Date _____
Residence _____ Citizenship _____
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Full Name of Fifth/Joint Inventor _____

Inventor's Signature _____ Date _____
Residence _____ Citizenship _____
(City, State) (Country)
Post Office Address _____

Full Name of Sixth/Joint Inventor _____

Inventor's Signature _____ Date _____
Residence _____ Citizenship _____
(City, State) (Country)
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Full Name of Seventh/Joint Inventor _____

Inventor's Signature _____ Date _____
Residence _____ Citizenship _____
(City, State) (Country)
Post Office Address _____

Full Name of Eight/Joint Inventor _____

Inventor's Signature _____ Date _____
Residence _____ Citizenship _____
(City, State) (Country)
Post Office Address _____

Full Name of Ninth/Joint Inventor _____

Inventor's Signature _____ Date _____
Residence _____ Citizenship _____
(City, State) (Country)

11. JUN. 2002 9:31

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NR. 465 S. 9/11

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